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Research Article

MEDICAL DIAGNOSTIC EXPERT SYSTEM FOR MALARIA AND TYPHOID FEVER

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Abstract

Expert System is computer software application which has the ability to replicate the thinking and reasoning capacity of human-being based on some facts and rules presented to it. Today expert systems have been used in almost all the fields to assist the users in decision making. They act like experts and provide the expertise decision and assistance for all the fields where human expatriation and complex decision making is required, like medical diagnosis, expert decision making, policy making, estimating strategies, analysis etc. The Expert system on Malaria and Typhoid Diagnosis is a software system designed to aid in the diagnosis of malaria and typhoid diseases. The software is a knowledge-based expert system. It is solely used by the user to see if he or she has any of the diseases listed in its domain, which the system afterwards prescribes drugs for the user. The software is interactive, with voice capabilities. The methodology adopted is Expert system development life cycle. The software is written in Visual Basic programming language. The system will be helpful to individuals, hospitals and other health institutions.

Keywords: Artificial intelligence, Expert System, Knowledgebase, Inference Engine, Expertise, Fuzzy System, Diagnosis, Signs, Symptoms, Forward Chaining, Backward Chaining, Test, Treatment.

INTRODUCTION

An expert system is divided into two subsystems: the inference engine and the knowledge base. The knowledge base represents facts and rules. The inference engine applies the rules to the known facts to deduce new facts. Inference engines can also include debugging and explanation abilities. Expert systems may or may not have learning components but a third common element is that once the system is developed, it is proven by being placed in the same real-world problem solving environment as the human SME, either as a support for human workers or as a supplement to some information system [1]. As a premier application of computing and artificial intelligence, the topic of expert systems has many points of contact with general systems theory, operations research, business process reengineering, and various topics in applied mathematics and management science. Two examples of real expert systems will help you understand how they work. In one real world scenario, a senior employee at a chemical refinery was ready to retire, and the firm was concerned that losing his experience in maintaining a fractionating tower would have a significant influence on the plant's operations [6]. A knowledge engineer was tasked with creating an expert system that would replicate his experience, preventing the organization from losing a valuable knowledge asset. Similarly, the Mycin system was designed using the experience of the finest bacterial illness diagnosticians, and its performance was found to be on par with or better than that of the average physician. In like manner, developing one of such system to represent the repository of the knowledge of a medical doctor is as essential as any other expert system [2]. To this end, this project, Expert System on the Diagnosis of non-communicable diseases (Malaria and typhoid) is a necessity.

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The Concept of Expert System

An expert system is an artificial intelligence software that emulates the decision-making ability of a human experts. It uses knowledge stored in a knowledge base to solve problems that would usually require a human expert thus preserving a human expert's knowledge in its knowledge base [6]. An expert system is built in a process known as knowledge engineering, during which knowledge about the domain is acquired from human experts and other sources by knowledge engineers. The acquired knowledge is then stored in knowledge bases, from which conclusions are to be drawn by the inference engine. The strength of an expert system is derived from its knowledge base - an organized collection of facts and heuristics about the system's domain. The accumulation of knowledge in knowledge bases is the hallmark of an expert system. The expert system utilizes what appears to be reasoning capabilities to reach conclusions. They can advise users as well as provide explanations to them about how they reached a particular conclusion or advice. They may also provide mathematical analysis of the problem(s) [9]. There are five basic types of expert systems. These include a rule-based expert system, frame based expert system, fuzzy expert system, neural expert system, and neuro-fuzzy expert system. A rule-based expert system is a straightforward one where knowledge is represented as a set of rules. Fuzzy logic expert systems are also called multi-valued logic and differentiate between members of the class from non-members in problem-solving [3]. In a frame-based expert system, frames are used to capture and represent knowledge. A neural expert system replaces a traditional knowledge base with neural knowledge, storing it as weights in neurons. Finally, a neuro-fuzzy system combines parallel computation and learning abilities with knowledge representation and explanation abilities [5]. The most common form of expert system is a computer program, with a set of rules that analyzes information (usually supplied by the user of the system) about a specific class of problems, and recommends one or more courses of user action [4]. A related term is wizard. A wizard is an interactive computer program that helps a user solve a problem. Originally the term wizard was used for programs that construct a database research query based on criteria supplied by the user. However, some rule-based expert systems are also called wizards. Other "Wizards" are a sequence of online forms that guide users through a series of choices, such as the ones which manage the installation of new software on computers, and these are not expert system [6].

Inference Engine

The inference engine is the processing component of the expert system. Its job is to pull relevant data from the knowledge base, interpret it, and come up with a solution that is relevant to the user's problem. To infer new facts, the inference engine uses rules from its knowledge base and applies them to known facts. Inference engines can also provide debugging and explanation capabilities [7]. For gaining knowledge from the Knowledge Base, the Inference Engine usually employs one of two strategies of either Forward Chaining or Backward Chaining . Forward Chaining – is a strategic technique used by the Expert System to answer the question – “What will happen next?”. This strategy is mostly used to manage duties such as coming up with a conclusion, result, or effect. For instance, consider a forecast or the current state of the stock market [8].

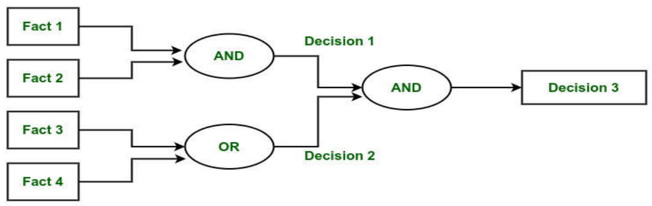

Figure 1. Forward Chaining

Backward Chaining – is a type of storage that the Expert System uses to answer queries like "Why did this happen?" This method is typically used to determine the root cause or rationale for an issue, taking into account what has already occurred. For instance, a diagnosis of stomach ache, blood cancer, or dengue fever, among other things.

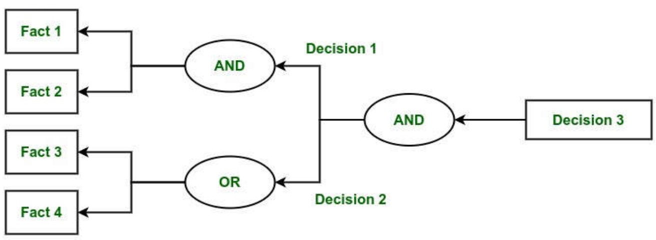

Figure 2. Backward Chaining

Review of Related Works: [11] presented an Expert System for the Diagnosis of Depression. An overview about depression disease is given, the cause of diseases outlined and the treatment of disease whenever possible is given out. SL5 Object Expert System language was used for designing and implementing the proposed expert system. Results: The proposed depression disease diagnosis expert system was evaluated by psychologist students and they were satisfied with its performance.

A novel framework called Dental Diagnosis System (DDS) for dental diagnosis based on the hybrid approach of segmentation, classification and decision making was proposed by [12]. It utilized the best dental image segmentation method based on semi-supervised fuzzy clustering for the segmentation task. A new graph-based clustering algorithm called APC+ for the classification task was proposed. A new decision making procedure was designed to determine the final disease from a group of diseases found from the segments. The system was modeled under the real dental case of Hanoi Medical University, Vietnam including 87 dental images of five popular diseases, namely: root fracture, incluse teeth, decay, missing teeth, and resorption of periodontal bone. The DDS accuracy is 92.74% which is superior to the other methods namely fuzzy inference system (89.67%), fuzzy k-nearest neighbor (80.05%), prim spanning tree (58.46%), kruskal spanning tree (58.46%), and affinity propagation clustering (90.01%).Empirical results established that superior performance of the DDS to other related methods the findings of the achieved results can assist dental clinicians in their professional work.

On Expert System for diagnosing eye diseases using forward chaining , PHP and MySQL were used [13]. The results obtained showed that the expert system was able to successfully diagnose eye diseases corresponding to the selected symptoms entered as query and the system evaluation through usability testing showed the expert system for diagnosis eye diseases had very good rate of usability, which includes learnability, efficiency, memorability, errors, and satisfaction so that the system can be received in the operational environment.

In their work, designing a Multi-Stage Expert System for daily ocean wave energy forecasting: A multivariate data decomposition-based approach , [14] opined that accurate forecasting of the wave energy is crucial and has significant potential because every wave meter possesses an energy amount ranging from 30 to 40 kW along the shore. By harnessing, it does not produce toxic gases, which is a better alternative to the energies that use fossil fuels. In this research, a multi-stage Multivariate Variational Mode Decomposition (MVMD) integrated with Boruta-Extreme Gradient Boosting (BXGB) feature selection and Cascaded Forward Neural Network (CFNN) (i.e., MVMD-BXGB-CFNN) is proposed to forecast daily ocean wave energy in the regions of Queensland State, Australia. The modelling outcomes were benchmarked via three other robust intelligence-based alternatives comprised of Multigene Genetic Programming (MGGP), Least Square Support Machine (LSSVM), and Gradient Boosted Decision Tree (GBDT) models hybridized with MVMD and BXGB (i.e., MVMD-BXGB-MGGP, MVMD-BXGB-LSSVM, and MVMD-BXGB-GBDT), and their counterpart standalone CFNN, GBDT, LSSVM, and MGGP models. The results showed that the MVMD-BXGB-CFNN technique, as a capable expert system, outperformed the other hybrid and counterpart standalone methods and has an adequate degree of reliability to forecast the daily wave energy in coastal regions. A smartphone- based expert system for COVID-19 was develop that publicly available COVID-19 dataset consisting of 33 features has been utilized to develop the aimed model, which can be collected from an in-house facility [15]. The chosen dataset has 2.82% positive and 97.18% negative samples, demonstrating a high imbalance of class populations. The Adaptive Synthetic (ADASYN) has been applied to overcome the class imbalance problem with imbalanced data. Ten optimal features are chosen from the given 33 features, employing two different feature selection algorithms, such as *K* Best and recursive feature elimination methods. Mainly, three classification schemes, Random Forest (RF), eXtreme Gradient Boosting (XGB), and Support Vector Machine (SVM), have been applied for the ablation studies, where the accuracy from the XGB, RF, and SVM classifiers achieved 97.91%, 97.81%, and 73.37%, respectively. As the XGB algorithm confers the best results, it has been implemented in designing the Android operating system base and web applications. By analyzing 10 users' questionnaires, the developed expert system can predict the presence of COVID-19 in the human body of the primary suspect. The preprocessed data and codes are available on the GitHub repository. [16] presented the development of the tool Circular Economy Business Modelling Expert System within manufacturing companies, intended to address these limitations. Based on systematised business modelling practices for circular economy and proactive advice on potential circular business model configurations, the expert system enhances strategic thinking for circular economy, supporting companies to come up with varied alternative business models with reasonable and viable value propositions to deploy circular benefits accordingly. The expert system was streamlined based on literature review, development, testing and evaluation with 12 practitioners from 10 companies. The paper discusses the main functionalities of the expert system and the results of its application into varied manufacturing companies. The application of the expert system has demonstrated to benefit companies with: inspiration for best practices on circular business modelling, a structured framework for confirming assumptions and a logic structure that prompts decision-making and reduces uncertainties.

In their study, employed Electromagnetism-based Firefly Algorithm - Artificial Neural Network (EFA-ANN) to forecast the energy consumption in buildings [17]. The model is applied to evaluate the heating load (HL) and cooling load (CL) using two given datasets. Each dataset was obtained by monitoring the effect of the façade system and dimensions of the building, respectively, on energy consumption. The performance of EFA-ANN is validated by comparing the obtained results with other methods. It is shown that EFA-ANN provides a faster and more accurate prediction of HL and CL. A sensitivity analysis is performed to identify the impact of each input on the energy performance of the building. From the results of this study, it is evident that EFA-ANN can assist civil engineers and construction managers in the early designs of energy-efficient buildings.

SYSTEM ANALYSIS

Analysis of the Existing System

The existing system involves many manual processes that are prone to human errors. The existing system is not reliable as its operation and processing ability is slow, clumsy and time consuming. The existing system is not flexible; patients will have to come down themselves to meet with the expert and the operation of the system is not efficient; even after opening a health history folder, it can be misplaced and information about the patient are easily. The system lacks a proper storage system. The process of retrieving the patient's health history folder is very difficult, as the patient has to search through a lot of folders to find her folder. When medical institutions take strike actions, the patient is not able to access the expert for as long as the strike action lasts. These and more, are part of the reasons for choosing an expert system that will solve the specified problems.

System Analysis of the New System

The proposed system will:

Provide a knowledge base for storing information that is elicited from the expert. This is to ensure that the patient will always have access to professional diagnosis. Have an interface where the user can register his/her details. This is to ensure the patient's medical history is documented and easily retrievable whenever it is needed. Provide an interface for retrieving symptoms from the user. The interface will be easy to learn, use and understand. Be able to analyse the symptoms supplied by the user and to deduce the nature of the sickness. This is made possible by the wealth of information contained in our knowledge base. Recommend medications based on the results on the diagnosis.

Medical Diagnosis Expert System for Malaria and Typhoid Fever

The objective of this design is to design and implement a system for the diagnosis of malaria and typhoid disease, which can be used by individuals at home or by medical attendants at a healthcare center to diagnose the symptoms and signs of patients to ascertain whether such ones have the disease. The diagnosis system which performs complete diagnosis on user symptoms would be much faster than any manual system. In this system all you need to do is to input data at the appropriate data boxes and click the diagnose button for the system carry out its diagnosis and bring out the result and prescriptions. The system requirements of usage is economical as compared to the manual system as it only requires a computer and software to be used. The system being a stand-alone software can be used at homes, which saves the users energy of having to go to the healthcare centers to diagnose themselves. The Home module is the main menu of the system that connects to the different other modules. It is the first page of the system that opens after the system lunches. It has the image below:

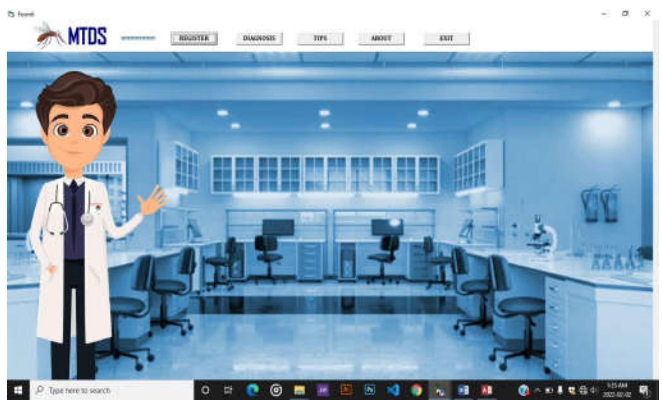

Figure 3. The Home module

The Registration Module is the page where users can input their information that will be saved in the database. The registration form contains the patient's ID, patient name, last checkup, address, occupation, phone number. It has the image below

Figure 4. The Registration module

The Diagnosis Module is the page where the user can input their symptoms in other to carry out the diagnosis operation and get a report of the result of the diagnosis. This module is where the knowledge base and the inference engine is coded which is the drive of the diagnosis system. It has the image below:

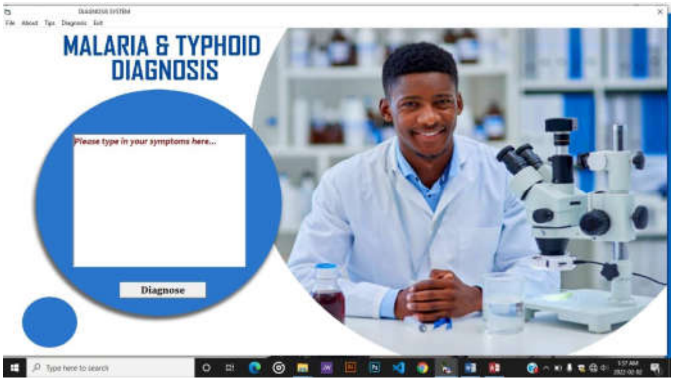

Figure 5. The Diagnosis module

The Tips module is the page that contains the information about the diagnosis system and how to use the system successfully. It has the image below:

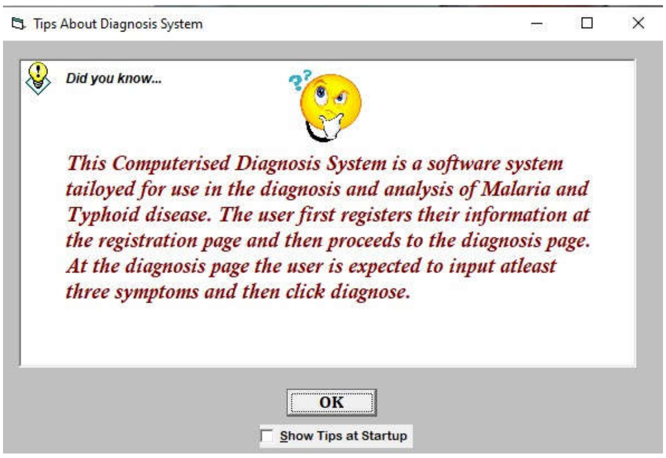

Figure 6. The Tips module

System Specification

The system is equipped with voice output that can be of help to the visually impaired users. It has the main menu where all the system modules can be accessed. It has the registration form where users can input there data. The system works with a database built by Microsoft Access, where the data of users are being stored. The system has a text box where the user can input their symptoms which is to be diagnosed and shows the result in a message box.

Database Algorithm

Start
Select action
If Action = yes then
Call Data-Access
Call Save. Procedure
Else if Action = Retrieve then
Call Data-Access
Call Open procedure
Else if Action. Search then
Get Search string
Call Data Access

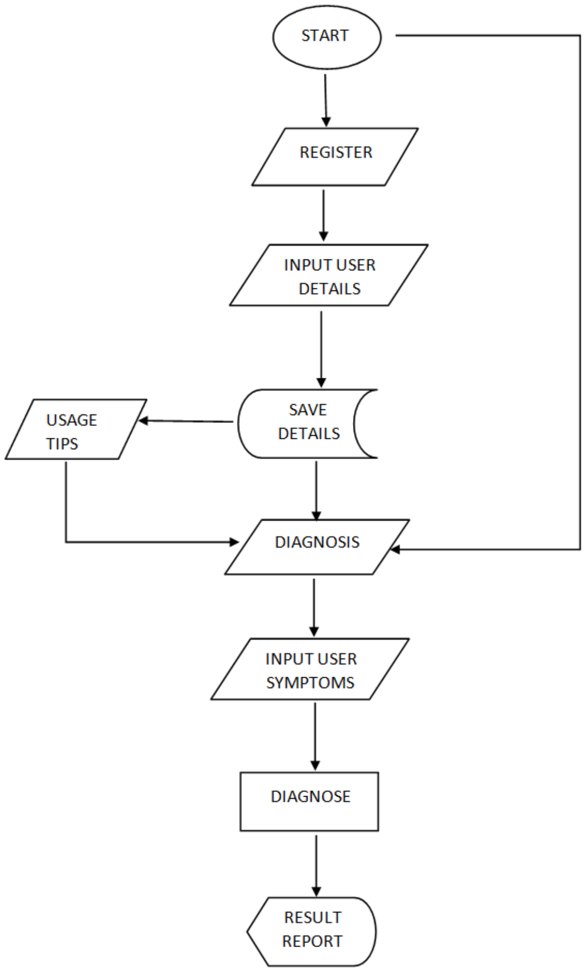

Figure 7. System Flowchart

Conclusion

Expert systems have been found to be very useful in our today's world driven by technology. When an expert's knowledge is extracted and stored, such knowledge can be used to substitute experts. Medical diagnosis will have greater part of the advantages of expert system, knowing that only a few specialties exist in the medical field. The knowledge of such specialist can be replicated and made use of in times extreme necessity. The development of expert system need be encouraged. At the end of this research work, I learnt several lessons. These include among others, malaria and typhoid disease conditions and their diagnosis based on symptoms. Also, I achieved the major aim and objective of this project work, which was to implement a computer Expert system on malaria and typhoid disease diagnosis.

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